U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 237.

Experiment Station Work,

XXXII.

Compiled from the Publications of the Agricultural Experiment Stations.

LIME AND CLOVER.
PLANT FOOD REQUIREMENTS OF FRUIT TREES.
APPLE GROWING IN NEW YORK.
RUNNING OUT OF SEED WHEAT.
HIGH-PROTEIN SEED WHEAT.
TOBACCO SEED SELECTION.
COVER CROP FOR TOBACCO FIELDS.
CEREAL BREAKFAST FOODS.
DAMAGED WHEAT AS FEED.
BEDDING FOR COWS.
AMATEUR POULTRY RAISING.
CARE OF CREAM ON THE FARM.
PAYING THE PATRONS OF CREAMERIES.
GASSY FERMENTATION OF SWISS CHEESE.
YEAST AS A DISINFECTANT.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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237

EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

CONTENTS OF NO. XXXII.

ILLUSTRATIONS.

EXPERIMENT STATION WORK.[a]

LIME AND CLOVER.[b]

Various explanations have been offered for the soil condition known as clover "sickness," or the failure of soils, otherwise productive, to yield good crops of clover; and it is doubtless true that various causes do contribute to this result, but that in many cases it may be due simply to an acid condition of the soil, which can be readily corrected by the judicious application of lime, the character of the growth of clover furnishing a very good means of determining whether lime is needed, is very clearly shown in experiments recently reported by C. E. Thorne, of the Ohio Station.

For a number of years it has been increasingly difficult to secure a crop of clover on the experiment station farm. The seed germinates and at first the stand appears to be good, but when the wheat is taken off the growth of clover is found to be uneven, there being patches of good clover interspersed with areas on which the plants are stunted. These areas increase in size as the season progresses. The clover on them is largely destroyed during the winter following the seeding, and by spring there is usually but little clover left.

This difficulty is not confined to the station farm, but is prevalent over a considerable part of northeastern Ohio. The soil on which this trouble is experienced is generally found to give an acid reaction under the litmus test, and the poorer the clover the more pronounced is the indication of acidity.

There is an evident relation between the previous treatment of the soil and the present behavior of clover upon it. Land which has been brought under cultivation at a comparatively recent date, or which has been kept in good heart by liberal and frequent use of manure in a well-planned crop rotation, is still producing fine crops of clover; but on lands which have been steadily cropped for half a century or more, with little manuring and a rotation of crops in which clover was grown but once in five or six years, and especially on those which have been stimulated to unusual production of cereals by the use of acid phosphate, without reenforcement by materials carrying nitrogen and potassium, there is a general and increasing failure of the clover crop. * * *

On the soil of the main station, naturally somewhat deficient in lime because of its origin, the condition unfavorable to clover is aggravated by the use of fertilizing materials originally compounded with acid, such as acid phosphate, potassium chlorid, and ammonium sulphate, although these materials are by

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[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Ohio Sta. Bul. 159.

no means the sole cause of this condition. On this soil a luxuriant growth of clover has been secured by the use of lime, in conjunction with materials carrying both phosphorus and potassium. Lime alone, though increasing the growth of clover somewhat, does not produce a full yield, nor does such a yield follow the use of lime in association with a carrier of phosphorus only, or of potassium only. When the lime has been applied to the corn crop two years before the clover seed was sown, the corn being followed by oats and wheat, the effect on the clover has been much better than when the lime was applied to the wheat crop the fall before sowing the clover seed.

Experiments made at other stations, especially the Rhode Island Station,[a] have indicated that the detection of an acid condition was a sufficient index of the need of liming. This conclusion is not entirely borne out by the experiments of the Ohio Station, since, although all three of the soils experimented with were acid, only two of them were benefited by liming. The behavior of clover on the different soils, however, was very characteristic. The growth on the soil which did not respond to liming was normal, while on the other two soils it was small and irregular until lime was applied.

Until we have more definite knowledge in this direction, therefore, we would recommend a careful study of the clover crop as an index to the need of any particular soil for liming, rather than exclusive dependence on the test for acidity, although that also should be employed.[b]

When the common red clover, after taking root in the spring, is found later in the season to be making no growth, and finally disappears in patches or altogether, then the need of lime is indicated. This condition of the soil is usually found in regions where the natural supplies of lime are scanty, the soils having been derived from sandstones or shales, and the small stores of lime reduced by long-continued cropping. The appearance of the plant known as sorrel, or horse sorrel (*Rumex acetosella*), is a further indication of the need of lime. Usually this plant first appears on the higher and poorer portions of the field, and as it becomes more abundant it gives to these portions the peculiar color from which it derives its name. Such soils are usually found to give an acid reaction to the litmus test.

There are, however, other soils which may be improved by liming. Heavy refractory clays, difficult to plow and breaking up into clods requiring much labor to pulverize, and producing a uniform and healthy appearing but small and unsatisfactory growth of clover, followed by equally unsatisfactory yields of other crops, may be completely changed in character by a large dressing of lime, the lime opening them up to the action of the weather and putting them in such condition that clover will grow luxuriantly. And where clover attains its normal growth any other crop ordinarily cultivated in Ohio may be successfully grown. This is to say, not that the growing of clover will dispense with the use of manures or fertilizers, but that a luxuriant clover crop will leave the soil in such physical condition that manures and fertilizers will produce their full effect upon subsequent crops, and that it will supply a large

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[a] U. S. Dept. Agr., Farmers' Bul. 133, p. 6.

[b] For means of detecting and correcting soil acidity and determining and supplying the lime requirements of soils, consult also U. S. Dept. Agr., Farmers' Bul. 77.

part of the nitrogen required by one or two cereal crops following. But it must be remembered that clover provides only nitrogen from sources outside the soil itself, and that it really facilitates the exhaustion of the soil stores of phosphorus, potassium, and lime, so that if soil fertility is to be maintained without impairment these stores must be replenished by fertilizing or manuring.

PLANT FOOD REQUIREMENTS OF BEARING FRUIT TREES.[a]

The amount of plant food which mature fruit trees in the full vigor of bearing use in one growing season has recently been reported by L. L. Van Slyke, O. M. Taylor, and W. H. Andrews, of the New York State Station. From one to three standard varieties were examined in each case. With each variety the fruit, leaves, and new growth of wood, as represented by the extension of the branches during the season, were gathered, dried, and analyzed. The fruit on the different trees was picked when ripe. The foliage was left until it showed a tendency to drop. The twigs of new wood were removed soon afterwards.

The apple trees in the experiment yielded during the season from 23 to nearly 30 bushels of fruit each, the peach trees from nearly 3 to over 4 bushels each, the pears from 1 to 5 bushels each, the plums from 1 to 1.75 bushels each, and the quince tree about 1.5 bushels. The following table shows the average amount of plant food used by each fruit tree of the different varieties studied:

Plant food used during a season's growth by a mature fruit tree in full bearing.

Variety.	Nitrogen.	Phosphoric acid.	Potash.	Lime.	Magnesia.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Apple	1.47	0.39	1.57	1.62	0.66
Peach	.62	.15	.60	.95	.29
Pear	.25	.06	.27	.32	.09
Plum	.25	.07	.32	.34	.11
Quince	.19	.06	.24	.27	.08

The above table shows the total amount of plant food used by the fruit, leaves, and wood of each kind of tree in one growing season. The figures might be considerably different with smaller younger trees, or larger older trees, or with trees not in bearing.

If the table is carefully examined it will be seen that—

the relative proportions of the different plant-food constituents are approximately the same for the different varieties of fruit trees. This means that, under like conditions of soil fertility, a mixture of nitrogen, phosphoric acid, and potash which would meet the requirements of one variety would also meet the needs of the other varieties, so far as the supply of these plant-food constituents is concerned. What particular proportions are best adapted to meet the needs of any particular soil can be determined only by special experiment.

[a] Compiled from New York State Sta. Bul. 265.

Using the above table as a basis, the amount of plant food used per acre by the different fruits can be easily determined. The following table shows the data thus deduced:

Plant food used per acre by different fruit trees and by wheat.

Variety.	Number of trees per acre.	Nitrogen.	Phosphoric acid.	Potash.	Lime.	Magnesia.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Apple	35	51.5	14.0	55.0	57.0	23.0
Peach	120	74.5	18.0	72.0	114.0	35.0
Pear	120	23.5	7.0	33.0	38.0	11.0
Plum	120	29.5	8.5	38.0	41.0	13.0
Quince	240	45.5	15.5	57.0	65.5	19.0
Wheat	[a] 20	30.5	12.0	16.2		

[a] Bushels.

This table shows that "peach trees used the largest amounts of plant food; apple and quince trees, approximately alike in the results given, come second, while pear and plum trees, which give results much alike, come third."

The amount of plant food used by a crop of wheat yielding 20 bushels of grain and a ton of straw per acre is included in the table for comparison. It can be readily seen that a heavy crop of fruit uses much more plant food during the growing season than a crop of wheat. If, therefore, it is considered necessary to fertilize the soil to secure a crop of 20 bushels of wheat per acre, it would seem even more necessary to fertilize for a crop of fruit.

The table shows further that—

the amounts of nitrogen and potash used by any one kind of fruit trees were approximately the same in most cases, while the amount of phosphoric acid was only about one-fourth the nitrogen or potash. In most commercial fertilizers used on fruit trees the phosphoric acid is present in proportions about 4 times the nitrogen. This is on the assumption that the soil contains more nitrogen relatively than phosphoric acid, which may or may not be true in individual cases. The question may be raised as to whether quantities of phosphoric acid are not frequently applied much in excess of the actual need of a season's crops.

PRACTICAL APPLE GROWING IN NEW YORK.[a]

The claim is sometimes made that the experiments conducted at the stations are often on so small a scale that practical farmers do not have faith in them, and that greater weight would be attached to the results if the experiments and observations were on a much larger scale or were carried out under such conditions as confront the farmer himself. Of unusual interest, therefore, from this standpoint, is the work recently reported by G. F. Warren, of the New York Cornell Station, in which he gives the results of his examination of 1,138

[a] Compiled from New York Cornell Sta. Buls. 226, 229.

apple orchards, covering 8,642 acres, in Wayne and Orleans counties, N. Y. Both of these counties are extensive apple-growing regions. In one township every orchard as large as an acre in extent was visited. Observations were made on such factors as location, site, aspect, soil, management, distance between trees, pruning, present condition of the orchard, orchard troubles, etc.

In Wayne County Mr. Warren found the average yield for four years of 31 orchards, which had been tilled five years or more, to be at the rate of 266 bushels per acre. Thirty-five orchards which had been tilled most years averaged 229 bushels per acre. Forty-two orchards in sod most years, but occasionally tilled, yielded an average of 202 bushels per acre. Forty orchards which had been in sod more than five years yielded only 148 bushels per acre. These figures show an increased yield for orchards tilled five years or more of about 80 per cent over orchards which had been five years or more in sod.

This greater yield in the tilled orchards was found not to be due entirely to cultivation, since the man who took the trouble to till his orchard usually gave the orchard better care as regards fertilizers, spraying, pruning, etc. Considering, therefore, only orchards which were well cared for, the orchards tilled five years or more still gave about 35 per cent better yields than the orchards which had been five years in sod.

Many of the sod orchards examined were pastured with cattle, sheep, or hogs. The yield in 1902 of 22 orchards pastured with hogs was 271 bushels per acre; of 15 orchards pastured with sheep, 216 bushels per acre; of 54 orchards pastured with cattle, 159 bushels per acre; and of 47 orchards not pastured, 185 bushels per acre. It is thus seen that hogs were least and cattle most injurious in the orchard. Pasturing the orchard with either sheep or hogs, however, resulted in better yields than not pasturing.

About 30 per cent of the orchards examined in Wayne County were not fertilized; 60 per cent received barnyard manure, and a few orchards also received some commercial fertilizer and green manure. The average yield for the two years, 1902 and 1903, of 220 fertilized orchards was at the rate of 257 bushels per acre, and of 78 unfertilized orchards, 202 bushels per acre. This represents an increased yield of 55 bushels per acre for the fertilized orchards.

Relative to the value of spraying 66 sprayed orchards, representing 626 acres, yielded in 1903 at the rate of 280 bushels per acre, while 107 unsprayed orchards, covering 673 acres, yielded at the rate of 253 bushels per acre. The amount received for 8,430 barrels of sprayed apples averaged $2.02 per barrel, while 6,365 barrels of unsprayed apples brought but $1.80 per barrel.

The following data, secured in Orleans County, show the yield and

income from well-cared-for orchards sprayed different numbers of times in 1904:

Yield and income from orchards sprayed different numbers of times.

How treated.	Yields.			Portion of crop barreled.	Incomes.		
	No. of orchards.	No. of acres.	Average yield per acre.		No. of orchards.	No. of acres.	Average income per acre.
			Bushels.	*Per cent.*			
Unsprayed	43	381.0	328	66	54	449.5	$103
Sprayed once	33	352.0	346	74	30	316.0	139
Sprayed twice	70	701.0	374	78	64	644.0	143
Sprayed three times	27	247.5	414	87	25	236.5	184
Sprayed four times	6	43.0	569	77	6	43.0	211

The effect of distance between trees set before 1880 was studied in its relation to yield. The following four-year averages were found:

	Bushels per acre.
Trees not over 30 by 30 feet apart	186
Trees 31 by 31 to 35 by 35 feet apart	222
Trees 36 by 36 to 40 by 40 feet apart	229

Among other matters noted in the survey, drainage was deemed desirable in 54 orchards in one township. The yield of these 54 orchards in 1902 was at the rate of 203 bushels per acre, or 42 bushels per acre less than the average of orchards in the township. The four-year average yield of orchards on elevated sites in this same township was at the rate of 227 bushels per acre; on moderate and slightly elevated sights, 224 bushels, and on low sites 213 bushels per acre. "Evidently the site is not a very important factor. The best site is, doubtless, one that is sufficiently elevated to give good opportunity for air and water drainage, but not so high as to be sharply exposed to wind."

The kind of soil on which the orchard is located was not found of so much importance as the kind of treatment the soil received. Good crops were found growing on quite diversified soils. A well-drained deep loam is recommended.

The effect of renting orchards was well brought out in the data secured. The survey showed that 77 per cent of the orchards in Wayne County were managed by the owners, and 23 per cent by renters. The four-year average yield of orchards managed by the owners was at the rate of 210 bushels per acre, while in the orchards managed by renters the average yield was 174 bushels per acre.

This survey, covering as it does the actual practices of farmers in two of the most important fruit-growing counties of New York, and giving the actual results in yields and income by different methods of treatment in hundreds of orchards, is on a sufficiently large scale

to make the results obtained of more than usual value and interest. It is gratifying to find that the cultural methods long recommended by the experiment stations as a result of trials on a small scale hold true when applied to orcharding on a commercial scale.

RUNNING OUT OF SEED WHEAT.[b]

T. L. Lyon and Alvin Keyser, of the Nebraska Station, report experiments to determine what basis there is for the prevalent belief among farmers, grain dealers, and millers that a change of seed wheat from time to time is very desirable and that the productive power and quantity of grain deteriorate when it is grown continuously in the same locality.

In the experiment reported, seed obtained originally from Kansas and Iowa in 1899 has since that time been grown at the Nebraska Station with Nebraska-grown seed. A like comparison has been made since 1902 between western and central Kansas, Ohio, Iowa, and Nebraska grown seed.

The experiments resulted as follows:

> Seed wheat brought from a distance did not in any case prove as good as the locally grown seed of the same variety. Locally grown Turkish Red yielded better than imported Crimean for each of the three years tested. * * * Turkish Red seed brought from western Kansas yielded nearly as well as the Nebraska-grown seed and was of better quality during the drier years, but suffered more from scab or blight in 1903 and 1904.

These results are a notable addition to the rapidly accumulating evidence that locally developed seed is the most reliable and that individual farmers should give more attention to the production of their own seed. The bringing of high-priced high-bred seed from a distance—however valuable the seed may be under the conditions of soil, climate, etc., under which it was produced—is more than likely to prove a disappointment under the changed environment. The best seed for any locality is that wisely selected and carefully bred under the conditions peculiar to that locality.

SELECTION OF SEED WHEAT WITH HIGH PROTEIN CONTENT.[b]

Investigations are reported by J. N. Harper and A. M. Peter, of the Kentucky Experiment Station, which show that the hard flinty wheat kernels are the richest in protein. Flinty wheats, however, tend to become softer when grown year after year without selection. It is necessary, therefore, if the flinty character and high protein content are to be maintained, that seed should be carefully selected each year. It was found by examining the kernels from a large number

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[a] Compiled from Nebraska Sta. Bul. 89.

[b] Compiled from Kentucky Sta. Bul. 113.

of different heads of wheat that there was very little difference in the physical appearance of the individual kernels composing any one head except in respect to size, and that the grains from the several heads of any one stool were sensibly alike. The grains from different stools, however, often differed materially, some being flinty, others starchy. The larger kernels in the center of a head were richer in protein than the smaller kernels near the base and tip. The earlier varieties were found to be richer in protein than the later varieties. It is recommended that flinty kernels from the middle of the head of early varieties (if equally good in other respects) should be selected for planting in order to develop a high protein type of wheat. Such wheats are preferable, both from the baker's standpoint and from the standpoint of value as food. A simple machine to test the relative hardness of kernels by measuring the pressure required to cut them transversely has been devised by the station.

TOBACCO SEED SELECTION.[a]

In bulletins of the Connecticut State and Maryland stations A. D. Shamel and W. W. Cobey, of the Bureau of Plant Industry of this Department, point out the necessity for careful selection of seed plants, prevention of cross fertilization, and sorting of seed, in order to secure more uniform and better quality tobacco. The Maryland Station bulletin gives the following concise directions for procuring good tobacco seed:

(1) Save the best plants in the field for seed plants. During the cultivation of the crop and the suckering and topping processes a constant search for good plants should be made by growers.

(2) When good plants are observed, they should be plainly marked by a tag or rag tied to the plant, so that they may be easily found and to prevent them from being accidentally topped.

(3) Place a 12-pound manila paper bag over the flower heads of the selected seed plants before the first flowers open. Inspect the bags every few days for the first two weeks and raise them up farther on the growing stems, arranging them so as to prevent any injury from crowding in the bag during this period of growth.

(4) At the end of the season, when the seed pods are ripe, cut off the plants near the ground without removing the bags and hang them up in a dry place. The bags serve to catch the seed which may fall out of the capsules in drying.

(5) After the seed has thoroughly dried, shell it out of the capsules and separate out the heavy seed for use.

According to A. D. Shamel, as explained in the Yearbook of this Department for 1904 [b]—

The most satisfactory means of separating the light from the heavy seed is by using a current of air. A simple and effective device for the purpose is

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[a] Compiled from Connecticut State Sta. Bul. 150; Maryland Sta. Bul. 103; U. S. Dept. Agr., Yearbook 1904, p. 435.

[b] See also U. S. Dept. Agr., Farmers' Bul. 225, p. 10.

shown in figure 1. The material necessary for constructing this machine can be obtained by tobacco growers from almost any chemical supply house. The foot bellows (*a*) is connected by means of a rubber tube (*b*) to the valve tube (*c*). The glass tube (*d*) is fitted with a rubber cork (*e*), in which the valve tube is inserted. The top of the cork is covered with a piece of finely woven gauze, in order to prevent the seeds from entering the valve tube. About an ounce of seed for separation is placed in the glass tube, and a current of air is injected by means of the foot bellows. The strength of this current must be regulated by the valve (*c*), so that only the dirt, chaff, and light seed will be blown out of the top of the tube. It is advisable to screen out all of the large particles of hulls and trash before putting the seed in the tube.

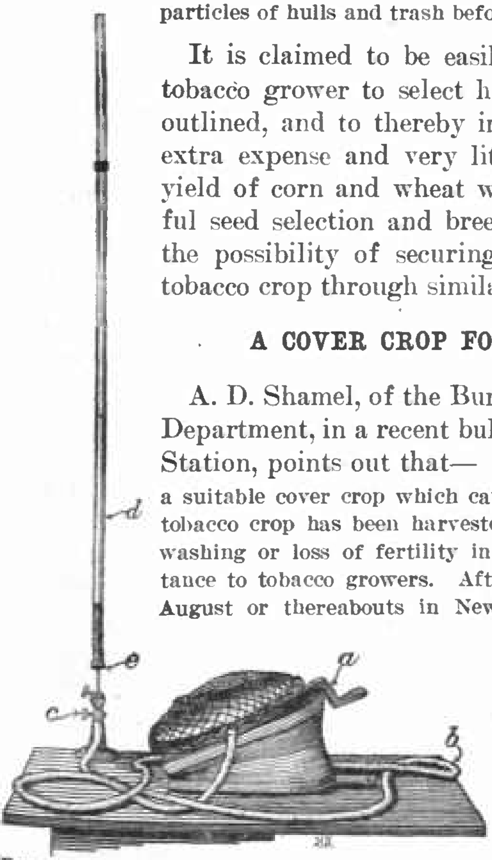

FIG. 1.—Apparatus for separating light and heavy seed of tobacco.

It is claimed to be easily within the reach of every tobacco grower to select his seed plants in the manner outlined, and to thereby improve his crop without any extra expense and very little labor. "The increase in yield of corn and wheat which has resulted from careful seed selection and breeding is sufficient evidence of the possibility of securing a like improvement in the tobacco crop through similar methods."

A COVER CROP FOR TOBACCO FIELDS.[a]

A. D. Shamel, of the Bureau of Plant Industry of this Department, in a recent bulletin of the Connecticut State Station, points out that—

a suitable cover crop which cau be sowed immediately after the tobacco crop has been harvested, so as to protect the soil from washing or loss of fertility in other ways, is of special importance to tobacco growers. After tobacco has been harvested, in August or thereabouts in New England, there is a considerable loss of plant food from the soil—lying bare for nearly nine months—by leaching and drifting of the surface soil; and the heavy fall and spring rains on sloping laud may badly wash and gully the fields.

A number of different kinds of cover crops, including rye, various clovers and other legumes, etc., have been used, but none has proved entirely satisfactory. Recent experiments, however, indicate that a crop well suited for this purpose is found in hairy or Russian vetch. "It has a peculiar habit of growth, and when sowed alone the plants spread out on the surface of the ground, covering it completely with a dense matted growth." The fact that the vetch is a nitrogen

[a] Compiled from Connecticut State Sta. Bul. 149.

gatherer makes it of special value for many tobacco soils which are relatively poor in nitrogen.

Russian vetch requires moisture during the first few weeks of growth, but after it becomes established is one of the best drought-resisting forage plants grown. The plant withstands cold, heat, and drought, but does not do well where water stands in the soil or covers the land. It has very fine small roots, which penetrate the soil in every direction, and when the plants are turned under they rapidly decay and give up their plant food to the succeeding crop. * * *

Owing to the large size of the seed—about the size of a small pea—a stand is easily secured in the fall, and when sowed at this time the plants will cover the ground before cold weather. The best way of seeding is probably to plow the land and broadcast, harrowing in the seed with a light smoothing harrow. If it is to be sowed with the greatest possible economy of seed, it should be planted in drills 2 to 4 feet apart and cultivated several times until the plants cover the ground. The seed should be sowed as soon as possible after the tobacco is cut, and at the rate of about 1½ bushels of seed per acre broadcast. When sowed in drills, probably from three-fourths to 1 bushel per acre will suffice. The best time for sowing is probably between August 1 and September 15.

When planted on land which has not borne this crop before, the seed should be inoculated before sowing, * * * or the soil may be inoculated by sowing on it, with the seed, surface soil from a field where this vetch has been recently and successfully grown.

CEREAL BREAKFAST FOODS.[a]

The number and variety of cereal breakfast foods at present on the market is large, but as pointed out by L. H. Merrill, of the Maine Agricultural Experiment Station, who has been engaged recently in a study of the digestibility and food value of this class of goods, in cooperation with this Department, the majority of them fall readily into three groups. The first would include those which are prepared by simply grinding the decorticated grain, the second those which have been steamed or otherwise partially cooked and then ground or rolled, and the third those preparations which have been acted upon by malt, which induces a greater or less chemical change in the starch present. The earliest of the cereal breakfast foods which came into general use in the United States were of the first class, oats being the most commonly eaten. Coarsely ground uncooked wheat does not seem to have been so generally used for preparing a breakfast dish, though corn meal and hominy have long been and still are popular. As the use of cereal breakfast foods became more common, the raw products were to a considerable extent replaced by the so-called rolled oats and wheats constituting the second group, and these goods are commonly conceded to surpass the simpler old-fashioned raw products in ease of preparation in the household and

[a] Compiled from Maine Sta. Bul. 118. See also Maine Sta. Buls. 55 and 84 for earlier work by C. D. Woods and L. H. Merrill.

in other ways. The manufacturers claim that the malted and otherwise specially prepared goods of the third class represent a still further advance.

In the manufacture of the malted goods barley malt is mixed with the cereal under conditions favorable to the action of the ferment present, the result being that some of the cereal starch is converted into a soluble form.

Some of the malted and other cereal foods are fully cooked, as by parching in addition to steaming, and may be eaten dry without further preparation, or, as many prefer, with the addition of cream and sugar. In a few cases the manufacturers cater still further to the popular taste by wetting the cereal with a salted or sweetened solution, after which it is again dried and slightly browned.

As regards composition, the figures published by Professor Merrill show that, as is obvious indeed from their appearance, the cereal breakfast foods are comparatively dry products, the average moisture content of the different sorts of corn, wheat, and oat products included in his comparison being not far from 9 or 10 per cent. Rolled oats, which he selected as a basis for comparison in his discussion, has the following percentage composition as shown by the average of a number of analyses: Water 8.4, protein 15.6, fat 7.5, carbohydrates 66.6, and ash 1.9 per cent, the heat of combustion being 4.323 calories per gram. The rolled oats contained considerably more protein, fat, and ash than rolled wheat, corn meal, or hominy, and also furnished more energy. It is, however, surpassed by the corn and wheat products as sources of carbohydrates. It should be remembered that corn in its natural condition contains on an average about 4 per cent fat. The small amount, 0.7 per cent, found on an average in the corn meal and hominy analyzed is due to the removal of the germ in milling. The malted products examined were more thoroughly dried than the other goods, containing only about 7 per cent water. Otherwise their percentage composition did not vary greatly from that of the corresponding unmalted cereals.

Analyses made at different times of the same brand [of cereal breakfast foods] show great variations in composition. This is not strange when it is remembered that there are many varieties of these cereal grains varying much in composition, and that even the same variety will show wide differences in composition according to the character of the season and of the soil and fertilizer used.

A number of digestion experiments were made in which rolled oats, rolled wheat, granulated corn meal, hominy, and some of the common commercial brands of specially prepared breakfast foods were studied. The ready-to-eat goods were used as manufactured. The rolled oats and wheat were cooked for forty-five minutes in a

double boiler. In general, about 90 per cent or over of the organic matter was retained in the body when the cereals were eaten with a mixed diet containing bread and meat, with a simple diet of cereal, cream, and sugar, and also when the results were computed for the cereal breakfast food alone. In the case of the mixed diet the highest percentage of digestible protein, 93.2, was noticed with the rolled wheat ration, and the lowest, 88.9 per cent, with hominy. In case of the simple diet, the range in digestible protein was from 82.3 per cent with granulated corn meal to 91.6 per cent with the rolled wheat ration. Considering the results for the cereal breakfast foods alone, the lowest value, 57.7 per cent digestible protein, was noted with a specially prepared whole-wheat product, and the highest value, 85 per cent, with rolled oats. The available energy was high in all cases. It was not far from 95 to 97 per cent with the mixed diet. With the simple diet the range was somewhat greater, namely, 91.1 per cent with a specially malted cereal to 96.4 per cent with hominy. With cereals alone the lowest value was 84.1 per cent available energy with a specially prepared whole wheat cereal, and the highest value, 94.4 per cent, with hominy.

According to the author corn products with a mixed diet and with a simple diet made a favorable showing as regards both total organic matter and energy, but were inferior to the other goods in respect to the digestibility of protein.

If the value of the cereal breakfast foods be based upon the digestibility of the protein when the foods are used with a mixed diet, rolled wheat must be placed first and corn products last. When the digestibility of the cereals alone is considered, rolled wheat ranks first, not only in digestibility of the total organic matter, but also with respect to the protein. The rolled oats rank next, and the corn preparations and the specially prepared whole-wheat product the lowest of all.

Treating the cereals with malt at the factory increases somewhat the amount of dextrinized starch present and, according to the manufacturers' claims, increases digestibility, but, as pointed out by Professor Merrill, cooking also renders starch soluble and "we may conclude, therefore, that the dextrinization of these goods by the manufacturers is in itself of little importance so far as the digestibility of the food is concerned, unless the preparations are to be eaten without further cooking. * * * The housewife finds a material gain in time in the use of cooked or partially cooked cereals."

The importance of thorough cooking is emphasized, and an hour at least is recommended in the case of hominies and old-fashioned oatmeals; and though it is asserted that the rolled cereal products may be prepared in ten to twenty minutes, in most cases it will be

found advisable, according to the author, to cook them for a longer time.

In a study of cereal breakfast foods reported by Harry Snyder,[a] of the Minnesota Experiment Station, the difficulty commonly experienced in digesting imperfectly cooked oatmeal is attributable to the large amounts of glutinous material which surround the starch grains and prevent their disintegration. When thoroughly cooked the protecting action of the mucilaginous protein material is overcome, and the compound starch granules are sufficiently disintegrated to allow the digestive juices to act.

The increased digestibility of the thoroughly cooked cereal, Professor Snyder believes, is largely due to a physical change in the carbohydrates, which renders them more susceptible to the action of digestive juices.

In connection with the Maine investigations the importance of the ash constituents of cereal breakfast foods is discussed. The advocates of the extended use of cereal breakfast foods lay much stress upon the large amount of mineral constituents (lime, phosphorus, and iron) which they are said to contain as compared with white flour.

The oat and wheat breakfast foods contain from 1.5 to 2 per cent of ash constituents; graham flour carries an equally large amount, while patent flour contains only about one-half of 1 per cent. Hence it is said that we should eat the coarser flours; or if we persist in eating bread of patent flour, we should supplement our diet by the use of cereal breakfast foods. If there is any force in this argument it lies in these two assumptions: First, that white flour, as now milled, no longer contains enough ash constituents to satisfy the needs of the body. Second, that bread flour and the cereal breakfast foods are the only sources from which the body may derive mineral matters. In point of fact, an average diet, even though it does not include coarse flour and cereal breakfast foods, probably carries the mineral salts in quantities largely in excess of our needs.

In general, the author concludes that—

while the modern methods of milling cereal breakfast foods have changed the mechanical condition of the cereal, and in many cases the form of the carbohydrates as well, yet the actual nutritive value is for the most part a characteristic of the cereal itself, and is changed but little by its method of preparation. * * *

It has been claimed that cooked or partially cooked cereals possess superior keeping qualities. If this be true, it is probably due to the sterilizing effect of the heat employed in their preparation and the greater dryness of the product. * * *

The investigations made at [the Maine] station have thus far failed to discover any fixed relation between price and nutritive value. It is only fair to add, however, that, whatever the relative food values of malted and unmalted foods, the cost of the former to the manufacturer is greater, and the increased price is to this extent justified.

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[a] Minnesota Sta. Bul. 74.

In the selection of cereal breakfast foods the consumer may be guided by the claims of the manufacturer, by the results of analyses of disinterested chemists, by the digestibility as determined by actual tests, by cost, by taste, by economy, or by the observed effects of the foods upon individuals. In the author's opinion the chemical composition, considered in connection with digestibility and cost, furnishes a satisfactory guide for selection, due attention being paid to palatability and individual preferences.

An earlier number of this series [a] contains a summary of experiment station investigations regarding the chemical composition of cereal breakfast foods.

More recently a number of the experiment stations have studied various problems connected with cereal breakfast foods. This work has included among others studies of the composition, comparative cost of these goods, and value of predigested cereal foods by J. B. Weems and C. E. Ellis; [b] experiments on the digestibility of cereal breakfast foods, by W. O. Atwater; [c] and the composition of cereal breakfast foods, especially the amount of soluble constituents which they contain, and related topics, by F. W. Robison,[d] of the Michigan Station. The Connecticut Storrs Station has published an article by R. D. Milner,[e] which summarizes information regarding the composition of cereal breakfast foods and their digestibility, and discusses the various problems connected with their nutritive value.

DAMAGED WHEAT AS FEED.[f]

Every year more or less of the wheat crop is damaged by excessive moisture, freezing, rust, or other diseases, etc., and is for that reason of poor milling quality and unmarketable. In particularly good seasons the amount of wheat of poor quality produced may be so small as to be of little importance, but in unfavorable seasons the proportion of inferior wheat is often so large as to make its profitable utilization a very serious and important problem.

Several years ago D. N. Harper, of the Minnesota Station, made a very thorough study of a large number of samples of wheat which had been damaged by frost, rust, and a number of other agencies, and showed that while such wheats were in most cases of poor quality for

[a] U. S. Dept. Agr., Farmers' Bul. 105, p. 19.

[b] Iowa Sta. Bul. 74.

[c] Connecticut Storrs Sta. Rpt. 1904, p. 180.

[d] Michigan Sta. Bul. 111.

[e] Connecticut Storrs Sta. Rpt. 1904, p. 210.

[f] Compiled from California Sta. Rpt. 1901, p. 56; Canada Expt. Farms Bul. 15; Rpts. 1892, p. 213; 1893, p. 254; Minnesota Sta. Bul. 90; South Dakota Sta. Bul. 90; Utah Sta. Rpt. 1900, p. LXIII; Wallace's Farmer, 29 (1904), No. 49, p. 1502.

milling and for seeding, they contained on the average somewhat higher percentages of protein than normal grain, thus indicating "that they would be good for feeding purposes." His results and conclusions have been confirmed by more recent analyses by H. Snyder, of the same station, of samples of rusted wheats, which showed such wheats as a rule to contain higher percentages of protein, fiber, and ash, but less carbohydrates, than fully matured grain from rust-free plants grown under the same conditions. One of the samples of rusted wheat examined by Snyder contained as high as 19.3 per cent of protein, while normal wheat contains on the average only about 12 per cent.

F. T. Shutt, of the Canada Experimental Farms, found that the grain of rusted wheat is "small, immature, rich in protein, and deficient in starch."

M. E. Jaffa, of the California Station, reports analyses showing that shrunken wheat contains 17.1 per cent of protein and 66.78 per cent of carbohydrates, as against 11.7 per cent of protein and 72.65 per cent of carbohydrates in plump wheat.

These investigations all indicate that any unfavorable condition which interferes with growth and hastens maturity generally results in the production of grain which is higher in protein and lower in carbohydrates than normal grain. And while such grain may be of inferior quality for milling, it may from the standpoint of composition be of somewhat increased value for feeding purposes.

As L. Foster points out in a press bulletin of the Wyoming Station, a number of experiment stations, notably those of Kansas, Maine, Michigan, Ohio, Utah, Wyoming, and Canada, have made experiments which show that when properly fed wheat gives results with all kinds of stock practically equal to those produced by corn.

> In both composition and digestibility it is superior to corn, but it differs from corn in the fact that when fed alone stock will not eat it as well and do not seem to have the same relish for it, because it is too sticky when ground, adhering to the teeth and gums. There is greater danger, too, of overfeeding than with corn, but when fed in connection with other grains, or particularly with bran, there is little danger of getting the animals off feed, and all kinds of stock then seem to like it fully as well as corn and make equally as good gains on it.

There is good ground, therefore, for the belief that when for any reason a considerable amount of wheat is produced which can not be marketed to advantage it can be profitably utilized as feed.

In Canada and other northerly regions frozen wheat is probably the most common form of damaged wheat, and has therefore been more extensively experimented with than other kinds. The analyses which have been made of frozen wheat indicate that it is likely to be slightly poorer in food constituents, especially protein, than normal wheat, probably owing to the fact that it has been arrested in the

process of maturing and not hastened to maturity, as in case of rusted wheat, for example.

In experiments made in Canada frozen wheat gave a return of about 60 cents per bushel when fed to steers, and from 45 to 75 cents per bushel to pigs, depending upon the way it was fed. The best results were obtained when the grain was ground or soaked for twenty-four hours before feeding. Both the beef and the pork produced was of superior quality. In experiments at the Utah Station frozen wheat was compared with good wheat and wheat screenings as a feed for sheep. The animals made profitable gains on all three feeds, the screenings (containing alfalfa and clover seed, cracked and shrunken wheat, etc.) giving somewhat better results than either frozen wheat or good wheat.

According to J. W. Wilson, of the South Dakota Station, a considerable amount of wheat in the northwestern part of the United States was damaged by rust in 1904 and its value lessened for milling purposes. In comparative tests of the feeding value for pigs of two lots of such damaged wheat weighing, respectively, 57 and 44 pounds per bushel, he found that rating pork at 4 cents a pound the heavier wheat gave a return of 63 cents, the lighter 57, per bushel. The heavier wheat contained 13.21 per cent of protein and the lighter 12.01 per cent, and practically the same amount of carbohydrates, 72 per cent. The heavier wheat was not only a richer feed, but was apparently more digestible than the lighter.

While no careful experiments on the subject are recorded, the indications are that many of the damaged wheats are, as a rule, somewhat less digestible than normal wheat on account of their poor physical condition, which prevents thorough mastication. In order, therefore, to get the full benefit of such feeds they should be ground or thoroughly soaked, or both ground and soaked before use. The Canadian experiments indicate that unground or cracked grain should be soaked forty-two hours, and that ground grain is improved by soaking at least twelve hours. As already indicated, the wheat should not be fed alone, but gives best results when fed in connection with other grain feeds or mill products, such as bran, or with succulent root crops. At the Canada Experimental Farms pigs were fed as much ground frozen wheat as they would eat up clean, in connection with as much skim milk as they would drink, with excellent results both as regards rate and profitableness of gain and quality of pork produced.

BEDDING FOR COWS.[a]

Wheat straw is quite generally and satisfactorily used as bedding material for cows where dairying is carried on in connection with

[a] Compiled from Maryland Sta. Bul. 104.

general farming. Where dairying, however, is the principal industry of a farm the supply of wheat straw is likely to be deficient and the question of securing bedding material becomes then and occasionally at other times an important problem. To gain information as to the value of various substitutes for wheat straw was the object of experimental work conducted recently by C. F. Doane at the Maryland Experiment Station.

While bedding material for cows should be as free as possible from dust and dirt that might get into the milk, should not irritate the skin of the animals, and should conform to other requirements, two very important considerations—those studied by Doane—are the keeping of animals clean and the power of absorbing liquid manure.

The cutting of wheat straw did not result in a saving of bedding material, as even with a much larger quantity of the cut straw the cows were not so clean. As indicated by the experiments, 2,300 pounds of cut straw or 1,800 pounds of uncut straw would be required per cow yearly in order to keep animals equally clean.

Cut corn stover was compared with whole wheat straw. About one-third more, by weight, of the stover was required to accomplish the same purpose as the straw. The stover, nevertheless, was considered a more desirable bedding material than the straw, and where wheat is grown primarily for the purpose of securing straw for bedding it is believed that corn stover might be economically substituted to a considerable extent.

Sawdust was found the most satisfactory of the bedding materials tested. Unfortunately, it is not always available, and objections, moreover, have been made to sawdust manure. Shavings were found to be almost equally as good as sawdust; but the same objections have been raised to shavings manure as to sawdust manure. The tests indicated that about 1,100 pounds of shavings would be required yearly per cow. "For the strictly sanitary dairy, sawdust or shavings are the ideal bedding materials, though the ordinary dairy farmer could not be advised to buy when he could raise either the straw or the stover."

The absorption tests were made in the laboratory, and judging from the amount of water capable of being absorbed by each of the materials used, it was estimated that 2.8 pounds of cut stover, 3.3 pounds of wheat straw, 8.3 pounds of sawdust, or 3 pounds of shavings would be required to absorb the liquid manure produced by one cow in sixteen hours. The yearly cost of bedding at local prices was estimated at $2.55 for cut stover, $3.11 for wheat straw, $0.30 for sawdust, and $3.28 for shavings where cows are stabled sixteen hours per day, or $3.65, $4.15, $0.45, and $4.81, respectively, where the cows are stabled the entire time.

SAWDUST AND SHAVINGS MANURE.

The relative value of the manure produced with different litters was not studied in the experiments reported by the Maryland Station. There is a widespread belief, apparently not without some foundation in fact, that shavings and sawdust manure is inferior in several respects to straw manure. The principal objections which have been raised to sawdust and shavings manure are that (1) it is poorer in fertilizing constituents than manure made with straw, for example, because straw is itself richer in fertilizing constituents than sawdust. Litters in general are, as a rule, poorer in fertilizing constituents than the manure (solid and liquid) with which they are mixed, and therefore tend to dilute it and lower the percentage content of fertilizing constituents of the final product. Not only is sawdust poorer in fertilizing constituents than straw, but more of it is required than of straw to absorb the liquid manure. Shavings apparently have greater absorbtive power than sawdust. (2) Shavings and sawdust decompose much more slowly in the manure heap and in the soil than straw and similar litters. It is claimed, therefore, that on this account manure containing shavings and sawdust is so light and open in the heap as to be likely to ferment improperly and is very slowly converted into humus in the soil. While, therefore, definite experiments furnishing positive evidence bearing on the various objections enumerated are limited, it seems safe to conclude that sawdust and shavings manure is, as a rule, somewhat less valuable ton for ton than straw manure made under like conditions and requires to be handled and applied with more care, especially in case of heavy manuring on light dry soils.

SUGGESTIONS FOR AMATEUR POULTRY RAISERS.[a]

In a recent bulletin of the Connecticut Storrs Station, C. K. Graham makes a number of suggestions of value to the many people who raise a few chickens for their own use or for the local market, but not enough to justify them in investing the money necessary to equip a model poultry plant. The following is a summary of these suggestions:

SELECTION AND HANDLING OF EGGS FOR HATCHING.

Much depends upon the selection of eggs for hatching. Eggs for this purpose should be of uniform shape and size and thickness of shell. Rough-shelled, dirty, and mottled eggs with thin shells should be excluded. "There is some doubt as to the advisability of setting

[a] Compiled from Connecticut Storrs Sta. Bul. 36.

small eggs. While it is possible that they may be as fertile and produce as many chicks as larger eggs, it is probable that pullets from the former will have a tendency to lay small eggs;" small eggs should, therefore, be avoided.

Eggs which are over five days old should not be used. "Every egg should be carefully dated when taken from the nest in order to avoid error on this point. While good hatches have been secured from eggs that were three weeks old when placed in the incubator, as a rule they can not be expected to hatch well after they are ten days old."

In shipping eggs for hatching too much care can not be taken in packing.

An ordinary basket with plenty of excelsior in the bottom and the sides well cushioned makes an excellent receptacle. Into this the eggs, carefully wrapped, should be packed, and over them plenty of padding placed. Cheese cloth or cotton tacked over the top forms a satisfactory covering. Such a package, conspicuously labled "Eggs for hatching," can be shipped any distance and will reach its destination in good condition. Upon receipt of the package the eggs should not be removed until the hen or incubator is ready to receive them, but the [eggs] should be turned over daily.

BROODING HENS.

"Almost any broody hen can be made to sit if carefully handled. She should not be carried by the legs with her head hanging down, but with her breast resting in the palm of the hand. Transfer should be made at night, and the nest into which she is put kept dark for twenty-four or thirty-six hours." The hen should be kept free from lice.

REARING INCUBATOR CHICKS BY BROODY HENS.

"A hen to which incubator chicks are to be given should be free from lice and in a nest where other hens can not disturb her. In the evening 2 or 3 chicks, at least thirty-six hours old, may be placed under her from behind, care being taken not to excite her, lest she step on them. At least one chick of each color should be given her, for hens are apt to kill chickens of another breed, color, or size than those they have already adopted. The following morning she may be expected to mother as many as are given her.

"The first week is the most critical period in the life of the chick. Trouble is most likely to be caused by chills." Coops should be used which do not permit the chickens during this period to get away from the mother. Later they should be removed to a slat coop which allows them free range. It is not advisable, however, to allow the hen free range for at least two weeks.

If she is kept confined and fed coarse grains, while the chicks are being fed a few yards away on finer grains, she will soon forget to call them and probably

will start to lay in three or four weeks, and at the same time will continue to protect the chicks during nights and unpleasant weather. If the chicks are to be distributed among several hens, it will be advisable to make colonies, care being taken to put those of about the same age together. Chicks of different ages should not be fed together, since the smaller ones will be crowded from the grain and will not thrive.

REARING CHICKS WITH BROODERS.

Those who prefer the artificial method of raising chicks can make a brooder out of an old packing case which will accommodate 50 chicks, at a cost of about a dollar. Such a brooder has given excellent results at the station when used in a shed or colony house. Details of construction of a brooder of this kind are shown in figures 2 and 3. The lower section of the brooder, which contains the lamp for heating, is a box 3 feet square made of 10-inch boards, which is covered with tin or galvanized iron. Above this cover, around the edges of the lamp box, 1-inch strips are nailed. Two 1-inch holes are bored through these strips on each side of the box for the purpose of ventilation. A floor of matched boards is laid on the strips. A hole 8 inches in diameter is cut in the center of this floor and over it is reversed an old tin pan 10 inches in diameter, the sides of the pan being punched full of holes to allow free circulation of heat. Over this is placed a table 2 feet 6 inches square, with legs $4\frac{1}{2}$ inches high. Around the sides of this table is tacked a curtain of felt cut from top to bottom at intervals of 5 or 6 inches to allow the chicks to pass in and out at will, the whole being surrounded by boards 4 inches high and 3 feet long nailed together at the corners and resting on the floor of the brooder. When the chicks are 10 days old one of these boards may be taken away and a bridge used so that the chicks may run from the hover to the floor of the room (see fig. 2).

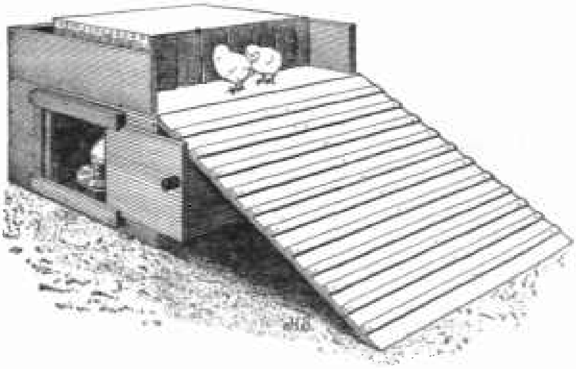

FIG. 2.—General view of home-made brooder.

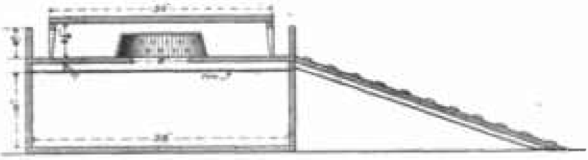

FIG. 3.—Section through middle of home-made brooder, showing details of construction.

A good brooder accommodating from 25 to 50 chickens can be bought of almost any incubator firm for from $12 to $16.

CARE OF YOUNG CHICKS.

In order to have a good, early maturing pullet it is necessary that she get a good start. The first few weeks' care is responsible to a great extent for her success or failure eight months later. Feed, regularity of feeding, cleanliness, and plenty of grit and water are all important matters. Chicks should be carefully protected from storms and sudden changes of weather, since these, together with the low vitality of the parent, are responsible for more deaths than is improper food. Poultrymen differ considerably as to when the chick shall have its first food. Good results have been secured when chicks have been permitted to pick a little sand or fine grit from a clean board when about 36 hours old, and, when about 48 hours old, to eat bread crumbs moistened in milk and squeezed dry. After that almost any of the prepared chick foods may be fed about five times a day till the chicks are 2 or 3 weeks old, when they will do well on wheat screenings and need not be fed oftener than three times a day. It is advisable to let the chicks have access to green feed at all times. Fine clover hay, cut with an ordinary straw cutter, is excellent, and also makes a good litter to scatter the feed in. It is best, however, to give the last food at night on a clean board, letting the chicks eat all they will and then removing the board. At other times care should be taken that they be kept hungry, or at least sufficiently so to be eager to eat when fresh food is offered them.

CARE OF CREAM ON THE FARM.[a]

In a recent bulletin of the Wisconsin Station discussing a number of creamery problems, E. H. Farrington makes some statements regarding the care of cream on the farm which are of special interest "to the creamery operator and dairy farmer in sections where farm separators have been introduced for separating the cream from milk." Attention is called to the fact that "these machines are now comparatively new to many of the farmers, and the change from daily delivery of whole milk to sending cream once or twice a week has made considerable difference in the methods of handling the milk and cream at the farms."

The problem of caring for the cream so that it may be delivered to the creamery in good condition is a serious one, because it has an important bearing on the quality of the butter. In many cases butter made from cream not properly cared for does not sell for the top market price, and since there is a growing tendency to sell butter on its merits, giving only the price its quality deserves, there will be difficulty in disposing of butter made from a poorer quality of farm separator cream at prices equal to those of butter made at whole-milk creameries. Considering the question, however, from the mechanical side of the butter-making process alone, there is no good reason why farm separator cream should not be equal to, if not better than, that separated at a factory with power separators.

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[a] Compiled from Wisconsin Sta. Bul. 129.

When milk is separated at the farm immediately after milking, the cleanest aud sweetest cream possible ought to be obtained; it certainly should be better than that skimmed by a factory separator from milk which is 2 to 20 hours old, and on this account a better butter should be made from the farm separator cream.

The usual causes of defective butter from gathered cream are: First, unsuitable places for keeping the cream, and, second, holding the cream too long before it is collected by the cream gatherers. A perfectly clean, sweet, and satisfactory cream is produced on many farms in the State and delivered in good condition to either a retailer, an ice-cream maker, or a creamery. There are, however, places where tainted and defective cream is found, and in some cases it is being mixed with cream of a better grade. This is hardly fair to the producer of first-grade cream, and in order to raise the standard of the entire product to a grade equal to the best the following suggestions are offered as a guide to persons not familiar with proper methods of caring for cream:

(1) Place the separator on a firm foundation in a clean, well-ventilated room where it is free from all offensive odors.

(2) Thoroughly clean the separator after each skimming. The bowl should be taken apart and washed, together with all the tinware, every time the separator is used. If allowed to stand for even one hour without cleaning there is danger of contaminating the next lot of cream from the sour bowl. This applies to all kinds of cream separators.

(3) Wash the separator bowl and all tinware with cold water and then with warm water, using a brush to polish the surface and clean out the seams and cracks; finally scald with boiling water, leaving the parts of the bowl and tinware to dry in some place where they will be protected from dust. Do not wipe the bowl and tinware with a cloth or drying towel; heat them so hot with steam or boiling water that wiping is unnecessary.

(4) Rinse the milk-receiving can and separator bowl with a quart or two of hot water just before running milk into the separator.

(5) Cool the cream as it comes from the separator or immediately after to a temperature near 50° F. and keep it cold until delivered.

(6) Never mix warm and cold cream or sweet and slightly tainted cream.

(7) Provide a covered and clean water tank for holding the cream cans, and change the water frequently in the tank so that the temperature does not rise above 60° F. A satisfactory arrangement may be made by allowing running water to flow through the cream tank to the stock-watering tank.

(8) Skim the milk immediately after each milking, as it is more work to save the milk and separate once a day and less satisfactory than skimming while the milk is warm, since the milk must be heated again when saved until another milking.

(9) A rich cream testing 35 per cent fat or more is the most satisfactory to both farmer and factory. The best separators will skim a rich cream as efficiently as a thin cream and more skim milk is left on the farm when a rich cream is sold.

(10) Cream should be perfectly sweet, containing no lumps or clots when sampled and delivered to the haulers or parties buying it.

There is a good demand for sweet cream and it can easily be supplied by keeping the separator, tinware, strainer cloth, and water tank clean, and the cream cold. The preceding recommendations when followed will pay well for what some may think is "a lot of extra bother."

PAYING THE PATRONS OF CREAMERIES.[a]

The amount of butter fat in milk or cream as determined by the well-known Babcock test has become generally adopted in this country as a basis for calculating dividends at creameries. Where a creamery is supplied with milk alone or with cream alone the problem presented is a simple one, but where both milk and cream are received at the same creamery and are not kept separate in the making of butter, the problem is somewhat more difficult, and as indicated by recent publications of the experiment stations, is not always satisfactorily solved.

One patron brings milk to the creamery, where it is tested and separated. He then takes away the skim milk containing a certain amount of butter fat which it is impossible to remove by the separator. Nevertheless he is credited with the whole amount of butter fat in the whole milk, although he carries away in the skim milk probably 3 per cent of what he brings. Another patron brings cream to the creamery, where the amount of butter fat it contains is also determined. In this case the patron receives no skim milk and hence takes away no butter fat. It is all used by the creamery. In combining the cream from the milk patron and the cream from the cream patron and dividing the proceeds on the basis of the butter fat supplied by each, it seems obvious that a deduction of 3 per cent should be made from the amount of butter fat in the whole milk of the milk patron or that a corresponding addition of 3 per cent should be made to the butter fat in the cream of the cream patron. The following illustration of the calculation of dividends under these conditions is taken, in substance, from an article by E. H. Farrington in a report of the Wisconsin Station.

Assuming that 125 pounds of butter are sold by a factory for $30, and that the factory receives 4 cents per pound for making the butter, which will amount to $5, this leaves $25 to be paid to the patrons A, B, and C, who supplied the following weights of milk and cream: A, 1,000 pounds of milk testing 4 per cent; B, 1,200 pounds of milk testing 3.8 per cent; and C, 100 pounds of cream testing 16.3 per cent.

The weight of butter fat from the cream patron should be increased by 3 per cent, and patron C, who delivered 16.3 pounds butter fat as cream, should accordingly have this 16.3 multiplied by 1.03, which gives 16.8 pounds.

The weights of fat from which each patron's share of the receipts are calculated will be: A, 40 pounds; B, 43.2 pounds; C, 16.8 pounds; or a total of 100 pounds fat, for which $25 was received. From this we find that 1 pound of fat is worth 25 cents.

The amount due each patron is then found by multiplying his weight of fat by this price per pound, and in this case we would have the following: A, 40

[a] Compiled from Vermont Sta. Bul. 100; Wisconsin Sta. Bul. 129, and Rpt. 1900, p. 90.

pounds fat, at 25 cents, $10; B, 43.2 pounds fat, at 25 cents, $10.80; C, 16.8 pounds fat, at 25 cents, $4.20.

In calculating the dividends of cream patrons when both milk and cream patrons come to one factory the weight of butter fat, found by testing the cream, is therefore multiplied by 1.03, and this result is taken as the total amount of fat delivered by the cream patron.

In a recent bulletin of the Vermont Station J. L. Hills discusses this subject, and gives rules for calculating payments and also simple and concrete examples. Butter weighs considerably more than the butter fat in the milk or cream from which it is made. The difference, known as the surplus or overrun, is greater in creameries receiving only cream from patrons than in creameries receiving only milk. The surplus or overrun in the cream-supplied creamery may be 2.5 to 5 per cent greater than that in the milk-supplied creamery. "A great deal of careful comparison and study has shown that in the long run the excess of surplus arising from the making of butter from the average gathered hand-separator cream, as compared with the manufacture of butter from average delivered milk, approximates 3 per cent." One method of calculating payments given in the Vermont bulletin is based upon the division of the surplus so that the cream patron shall receive 3 per cent more than the milk patron. It is advised that each creamery establish, if practicable, its own factor by periodical test churnings, and use that in preference to the 3 per cent factor, which represents an average. With this explanation the following rules may be given for dividing the surplus equitably between the two classes of patrons and making payments accordingly. The rules as well as the illustrations are taken with some changes in form from the Vermont bulletin.

To determine the milk-fat surplus (or the surplus due the milk patron) and the cream-fat surplus (or the surplus due the cream patron)—

(1) Multiply the pounds of cream fat by the adjustment factor, expressed decimally (i. e., 0.03, 0.025, 0.038). (2) Subtract the result from the total pounds of butter made from both milk and cream. (3) Subtract the total pounds of fat (milk fat and cream fat) from the result obtained in 2. (4) Divide the result obtained in 3 by the total pounds of fat (milk fat and cream fat). This gives milk-fat surplus expressed decimally. (5) Add adjustment factor, expressed decimally, to result obtained in 4. This gives cream-fat surplus expressed decimally.

A simple example:

Pounds of milk received 2,500, test 4 per cent	pounds fat	100
Pounds of cream received 571, test 35 per cent	do	200
Total fat received	pounds	300
Total butter made	do	345

From 100 pounds fat received as milk and 200 pounds fat gathered as cream 345 pounds of butter were made. The 3 per cent adjustment factor is held to be

applicable. If 1 pound of fat from cream made 3 per cent more butter than did 1 pound of fat from milk, then the 200 pounds of fat which were gathered as cream made 200 × 0.03, or 6 pounds more butter than would have been the case had these 200 pounds fat been bought as milk. Hence 339 pounds (345—6) represents the weight of butter which would have been made had all the fat been bought as milk, since by use of the adjustment factor the effect of the cream purchase on the surplus has been eliminated.

339—300=39 pounds true milk surplus.
39÷300=13, or 13 per cent true milk surplus, and
13+3=16, or 16 per cent true cream surplus.

To determine the amount of butter made from the milk fat multiply the number of pounds of fat by 1 plus the surplus expressed decimally. In the example given this would be 100×1.13=113. To determine the amount of butter made from the cream fat multiply the number of pounds of fat by 1 plus the surplus expressed decimally. In the example this would be 200×1.16=232. To determine the amount due each patron multiply the number of pounds of butter thus obtained by the price per pound.

Another method of reaching practically the same results where the patrons are paid on the basis of butter fat may be outlined as follows: Determine the surplus due each class of patrons as above. Determine the price per pound of butter fat to be paid the milk patron and the price per pound of butter fat to be paid the cream patron by decreasing the average price on the one hand and increasing it on the other in proportion to the surpluses expressed decimally. This difference is usually about one-half cent per pound.

GASSY FERMENTATION OF SWISS CHEESE.[a]

The manufacture of Swiss cheese is rapidly growing in the United States, and has already become an important factor in regions where special attention is given to cheese making, as in Wisconsin.

The industry is handicapped, however, more or less by serious losses due to abnormal fermentations. These are, as a rule, a consequence of careless methods, and result in defective cheeses.

In a recent bulletin of the Wisconsin Station H. L. Russell and E. G. Hastings report the results of a study of the causes of an outbreak of gassy fermentation of an unusual nature in Swiss cheese, which was the cause of serious loss in a factory in that State, due to the defective cheeses produced.

The defective condition here referred to does not appear while the milk is being worked up into cheese, nor immediately after they are taken from the press. The first abnormal condition is generally noted in the brine tank. When placed therein the cheese do not seem to absorb salt in the usual way, this condition doubtless being due to the absence of those normal ripening

[a] Compiled from Wisconsin Sta. Bul. 128.

changes which are associated with the breaking down of the casein. The first most evident symptom of trouble usually appears when the cheese have been on the shelves for a week or so. The edge of the cheese cracks or opens, generally near the junction of the top or bottom and the side. (See figs. 4 and 5.) This split continues to increase in length, running around the cir-

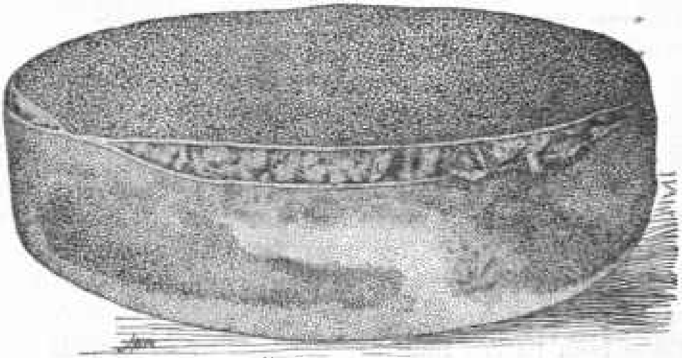

FIG. 4.—Side view of drum Swiss cheese, showing cracking of cheese at edge.

cumference of the cheese, and in severe cases the interior of the curd may be forced out through this crack.

In figure 6 this stretching of the plastic curd toward this opening is well shown. This is of course due to the pressure of gas within the cheese. Relief from this pressure occurs at this point because resistance is less here than elsewhere.

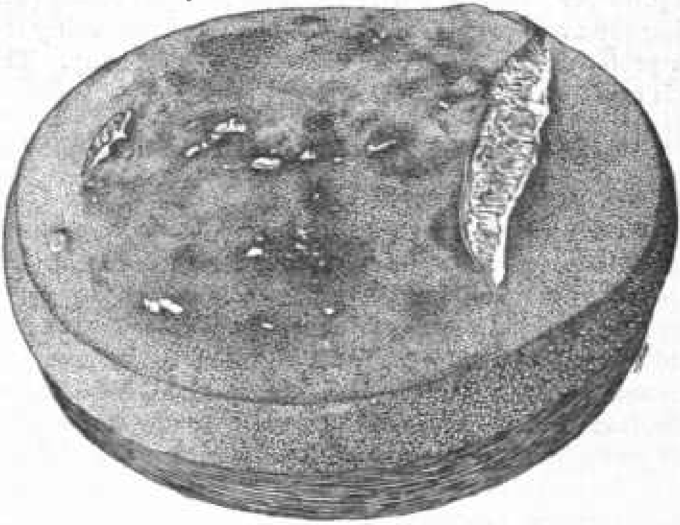

FIG. 5.—Top view of drum Swiss cheese, showing rupture of surface at several different points.

Sometimes the cheese "huff" without splitting in this way, but generally they do not show marked evidence from the outside. Usually the cheese have a poor texture, remain tough and rubbery, even when of considerable age. When a plug is drawn or the cheese is cut, the gaseous fermentation is usually very evident. The texture shows abundant gas holes of varying size. These are always more numerous than are to be found in a normal No. 1 Swiss. Some-

times cheese are found that split open on the edge and still show a solid body. In all cases, however, the flavor is decidedly off, a disagreeable sweet taste being observed. The affected cheese are also usually off in color. Very gassy cheese are badly bleached. Neither do the cheese seem to have the usual degree of acidity.

Investigation showed that the abnormal fermentation was due to the presence of yeast cells which in some unknown way had gained access to the milk and had passed into the cheese.

The trouble appears to be largely due to the factory methods and especially to the way the whey is handled.

Where the whey is held for twenty-four hours to allow it to sour, so as to permit the butter fat to be more thoroughly skimmed, yeast organisms of this type are almost sure to develop in greater or less numbers. * * * If the

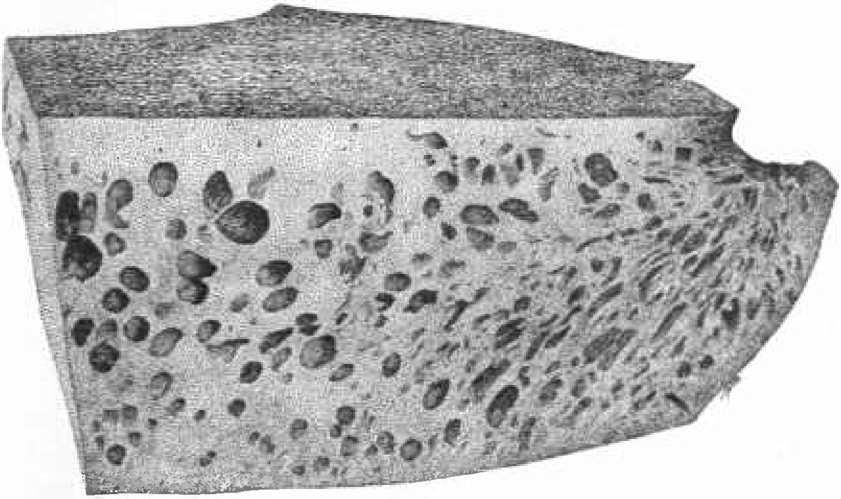

FIG. 6.—Section of affected cheese, showing the crack at junction of side and top.

butter fat left in the whey after the curd is taken out could be removed immediately or within a short time, no such development as this could take place. Such can be done by immediate separation of the whey in a cream separator. * * * The quality of the butter is enough better and the quantity secured enough larger to warrant the installation of machinery which will do this work. Of course, the installation of steam to furnish power could not economically be made in the smaller factories, but such a course would doubtless prove advantageous in the long run in the factories where a larger amount of milk is handled. The present custom of souring the whey is not nearly as satisfactory from this point of view as the now pretty generally discarded method of scalding the whey to get the butter fat.

The practice of soaking whole rennets in whey without boiling or heating the latter is condemned. The use of commercial rennet extracts is considered preferable. "If whole rennets are employed, heated whey should be used, and particular care should be given to the rennet jars, which should receive a thorough sterilization at frequent intervals.

"The quicker the whey can be delivered to the farmers the less likely are troubles of this sort to develop." Special pains should be taken to keep the receptacles clean in which the whey is stored. "Dangers from this source would be entirely eliminated if a different receptacle than the can used for the fresh milk was employed to carry back the whey to the farm. Old, discarded cans that are not fit to use for the milk could be utilized for this purpose."

When a factory once becomes badly infected thorough disinfection is necessary. Heat is naturally the most effective agent for destroying the germ.

If steam is at hand, even a momentary exposure is sufficient to destroy its vitality, but where reliance is had only on a scalding temperature (150° F.) it is necessary to prolong the period of exposure for at least ten or fifteen minutes. For washing the walls and floors of a factory a 2 per cent solution of hot lye will prove effective.

YEAST AS A DISINFECTANT.[a]

The use of yeast to destroy disease-producing bacteria has been recently proposed, and the treatment has attracted much attention on account of its simplicity, the harmless (nonpoisonous) character of the material used, and its apparent effectiveness. Trials made by the veterinarian of the Nebraska Station, A. T. Peters, indicate that the treatment will prove of value in veterinary practice.

The preparation of the yeast solution and its use is thus described by Doctor Peters:

Take one cake of either compressed or dried yeast, add enough water to moisten the same; then allow it to stand at least twelve hours, or preferably twenty-four hours. To this is then added a pint to a pint and a half of lukewarm water. This is used as the cleansing fluid. This treatment is especially promising in case of cows suffering from abortion. The animal to be disinfected is first washed out with lukewarm water, and after being thoroughly cleansed the disinfecting fluid is applied. The same method is pursued in the bull. This treatment is being tried on barren cows also. Knowing that the vagina of barren cows is exceedingly acid, it is hoped to overcome this acidity by repeated injections of fermented yeast germs before service.

The theory is that the acidity of the generative organs is due to bacterial activity, and that yeast solutions introduced as suggested invade all parts of the organs and destroy the bacteria which produce the acid condition.

The value of the treatment for disinfection of wounds and for use internally is also being investigated. The exact value and applicability of the method, as well as its mode of action, have not yet been fully worked out, but the investigations thus far made indicate that it is well worthy of careful trial.

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[a] Compiled from Nebraska Sta. Rpt. 1905, p. 10.

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